Neural Networks: Shifted Threshold Activation Functions

(1) A neural network has two input neurons N1 and N2 receiving inputs $x_1 = 1.2$ and $x_2 = 2.1$, respectively, and a single output neuron N3 generating an output s. The output neuron employs a shifted binary threshold activation function with an amount of shift $y_0 = 2$. The weights of the network are $w_{13} = 1.5$, $w_{23} = 0.5$, and $w_{o3} = -1$. Determine the output s.

(2) A neural network has three input neurons N1, N2, N3 receiving inputs x_1, x_2, x_3, respectively, and a single output neuron N4 generating an output s. The output neuron employs a shifted bipolar threshold activation function with an amount of shift y_0. The weights of the network are $w_{14} = 0.5$, $w_{24} = 1$, $w_{34} = 1$, and $w_{o4} = -0.8$. Find the value of y_0 such that the following three input-output patterns are implemented:

|	x_1	x_2	x_3	s
First pattern	0.8	0.4	1.5	-1
Second pattern	0.9	1.2	1.4	-1
Third pattern	1.7	0.6	1.9	1

(3) Investigate the solution of Prob. (2) when x_3

in the third pattern is reduced from 1.9 to 1.3.

(4) Consider a neural network with two input neurons and a single output neuron. The network is required to perform a logic AND operation. Specify a threshold activation function for the output neuron and evaluate the various weights of the network.

(5) If the network in Prob. (4) is required to perform a logic OR (instead of logic AND) operation using the same values of weights, specify a threshold activation function for the output neuron.

(6) The figure below illustrates a three-layer, two-input, two-output neural network. The two hidden-layer neurons employ binary threshold activation functions, while the two output-layer neurons employ shifted bipolar threshold activation functions with the same amount of shift y_o. For inputs $x_1 = 1$ and $x_2 = 2$ and corresponding outputs $S_1 = 1$ and $S_2 = -1$, determine the permissible range of values of y_o.

Answers

(1) $s = 0$
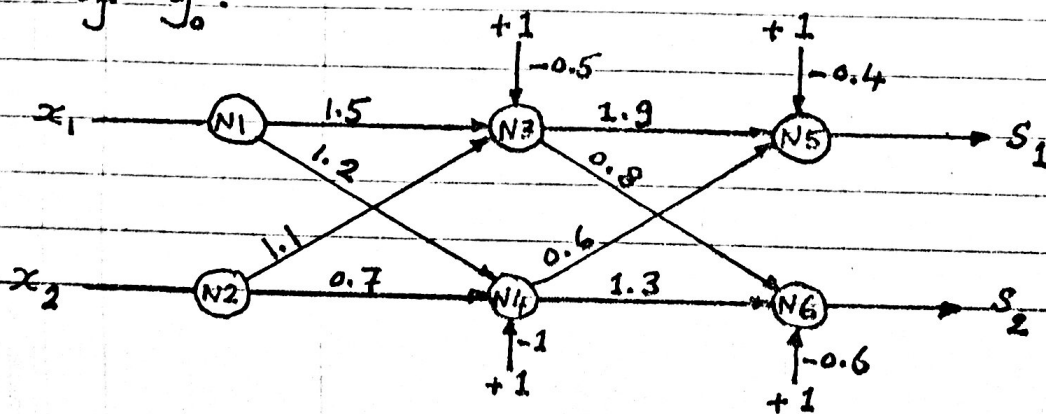
(2) $y_0 = 2.4$ (Possible answer)

(3) No solution y_0 can be found.

(4) Binary threshold activation function;
$w_{03} = -1.5$, $w_{13} = 1$, $w_{23} = 1$ (Possible answer)

(5) Shifted binary threshold activation function;
$y_0 = -1$ (Possible answer)

(6) $1.5 < y_0 < 2.1$

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